



thermoscientific

Confidence in every drop.

Beverage Analysis

ThermoFisher
SCIENTIFIC

A microscopic view of green plant cells, showing numerous circular structures with dark outlines, likely chloroplasts or cell walls, arranged in a somewhat regular pattern. The background is a vibrant green color.

Your Brand

And you can trust us to help keep it that way. As a matter of fact, the world's top ten beverage companies trust us to help keep their products and brands safe, consistent, unadulterated. They come to us for accurate, reliable answers across the broadest technology portfolio on the planet—ion, liquid and gas chromatography, metal analysis, mass spectrometry, discrete analyzers and data management.

is Everything

From routine analysis to high-end detection, you know the answers can affect so much more than your product; they can make or break your brand.

This brochure will help you understand what you WANT to look for in beverages, what you SHOULD look for and the INSTRUMENTS used to find it.



Beverage Analysis Video:
www.thermofisher.com/beveragetestingvideos

Juice should



Quality Control/Food Labeling/Authenticity/Adulteration

Carbohydrate Analysis

High-performance anion-exchange chromatography (HPAE) coupled with **pulsed amperometric detection (PAD)** is a well-established **ion chromatography (IC)** technique to identify and quantify carbohydrates in beverage samples.

It allows direct quantification of nonderivatized carbohydrates with minimal sample preparation and also resolves most carbohydrates from sugar alcohols and organic acid. Its selectivity ensures sodium chloride – commonly present in fruit juices – is not detected.

HPAE-PAD is a proven technique to determine authenticity of juices, especially when adulteration presents economic and regulatory issues. It can identify common forms of adulteration such as simple dilution of expensive juices with inexpensive or synthetically produced ones, and sweetener sources such as other juices or sugar derived from fruits or vegetables.

Contamination

Arsenic Species in Apple Juice

Media reports of apple juices containing high amounts of Arsenic (As) have triggered an increased interest in speciation analysis to determine potential toxicity. Coupling IC with ICP-MS provides a highly sensitive **speciation technique** to determine trace elements including As in beverages. **IC-ICP-MS** can identify both the highly toxic inorganic species of As(III) and As(V), as well as harmless organic species such as arsenobetaine.

ONLY be juice.

Authenticity

Anthocyanins in Pomegranate Juice

The **HPLC** technique is routinely used to measure the level of anthocyanins in pomegranate juice. Anthocyanins are a subclass of molecules known as flavonoids, responsible for the brilliant red, orange and blue colors of most fruits and flowers. They also have strong antioxidant properties. In fact, pomegranate juice has been reported to contain 3 times more antioxidant activity than green tea. As demand for pomegranate-related products has grown, adulteration of the juice has become widespread. This makes authenticating pomegranate juice via HPLC a critical analysis in the production of the product.

Quality Control

Sugars Analysis

Discrete photometric analyzers offer a fast, cost-effective enzymatic testing method to determine the amount of fructose and glucose in juice. Measuring the levels of sugar provides a strong indicator of quality, and helps determine the authenticity of fruit juice using a fruit's specific natural fructose/glucose ratio. Effective sugar monitoring during different production stages improves productivity and ensures consistent products.

www.thermofisher.com/juicetesting



Beer should



Quality Control

Phenolic Compounds

Beer is the most widely consumed alcoholic beverage in the world; that's why beer should only be beer. It's typically brewed from four basic ingredients: water, brewer's yeast, a starch source and a flavoring agent such as hops. Beer contains a complex mixture of phenolic compounds extracted from the starch source and hops. **HPLC** is often used to measure phenolics in beer and can be used in a metabolomic approach to distinguish between beer samples as well as study stability.

Inorganic Ions and Organic Acids

IC is often used to measure compounds of interest in beer such as inorganic ions, organic acids, and hop bittering principles that impact overall taste and bitterness. It can also determine the extent of fermentation by monitoring proteins, carbohydrates and alcohols. The finished beer can also be analyzed by IC to determine the concentration of added preservatives and colorants, in addition to ensuring manufacturing authenticity.

Sulfur Dioxide

System reagents and fully automated **discrete photometric analyzers** can provide a total system solution for sulfur dioxide (SO_2) analysis in beer production. Sulfur dioxide (SO_2) originates from yeast metabolism in beer and reacts with carbonyl compounds to form hydroxysulfonates which produce a stale, unwanted flavor. SO_2 also plays an important antioxidant role in beer and is known to exert antimicrobial properties at high concentrations. In the robust Gallery method, the reagents and analyzers help control concentrations of SO_2 during beer and cider production to ensure quality.

Bitter Acids

High resolution chromatographic separation can benefit the analysis of low molecular weight compounds in beer. These include vitamins, amino acids, proteins and bitter acids, all of which impart specific organoleptic properties to the beverage. The presence and quantity of such compounds are monitored to ensure a consistent product.



ONLY be beer.

MS acquisition of accurate mass data in both full scan and MS_n modes can enable detailed and confident structural characterization of bitter acids. Being a large group of closely related compounds, bitter acids differ in the type and location of a side chain substituent. They are of particular interest in beer analysis due to their considerable impact on taste.

Isohumulones

HPLC represents the only analytical method that enables specific quantitation of isohumulones (iso- α -acids), which are critical in beer production. Six major iso- α -acid variants are found in beer. They determine about 80 percent of the typical bitterness; their antimicrobial effect leads to a sterile beverage, their tensioactive character stabilizes the foam; and they greatly impact the flavor, smell and smoothness of beer. Our BeerNHop solution is an easy tool to accurately determine isohumulone profiles in beer.



www.thermofisher.com/beertesting

Wine should



Quality Control

Polyphenols and Catechins

Compositional studies of polyphenols have gained momentum in recent years due to their contribution toward the taste and appearance of wine, especially the formation of unappetizing flavors. Catechins, a type of flavonoid polyphenol, are major components in wine and are reported to have antioxidant, antimicrobial, antimutagenic and anticarcinogenic activities.

Reversed-phase HPLC with UV detection is the technique of choice for analyzing water-soluble, aromatic phenolic substances including catechins. High chromatographic selectivity and resolution is critical as polyphenols are structurally similar.

Copper and Zinc

Flame AAS can easily test for heavy metals in wine with a simple diluted sample. Many factors lead to the presence of metals in wine: soil, type of vineyard, steps in the production cycle, processing equipment, conservation and bottling. Excessive metal consumption through wine can compromise people's health, and metals can significantly impact the quality of the wine. In particular zinc, copper and iron can lead to haze formation in bottled wine. So winemakers need reliable screening for metals prior to bottling.

Acids

Acids contribute to the flavor, stability, color and pH of wine, so knowledge of desired acid concentrations during processing is a must for winemakers. Some acid is desired by yeast during fermentation, and final levels of acids contribute to the flavor complexity of wine as well as stop the growth of potentially harmful microorganisms that could spoil the end product.

Discrete photometric analyzers ensure speed, flexibility and precision for colorimetric and enzymatic testing of acids in wine to ensure a high quality finished product.



ONLY be wine.

Authenticity

Composition and Geographical Origin

With over 10,000 grape varieties, monitoring authenticity, adulteration and fraud poses a serious challenge for the wine industry. Isotopic analysis of wine has become a widespread tool to evaluate the quality, authenticity and origin.

HPLC or **GC combined with high resolution accurate mass (HRAM)** are tools that can provide a robust and confident means of profiling wine for authenticity testing.

Contaminants

Pesticides

Fungicides and insecticides are commonly used in vineyards to improve grape yields. However, pesticide residues can be transferred to the final product if they remain in the grapes prior to the winemaking process, and their presence poses a health risk to humans.

LC-MS/MS analysis effectively determines the presence of pesticide residues, especially when simple, effective **QuEChERS** sample preparation is done before the quantitative analysis.



Milk should



Quality Control

Choline

IC is a useful technique for the determination of choline, a water-soluble quaternary amine, in milk. Choline is essential to methyl metabolism, transmembrane signaling and normal brain development. It exists in many foods in esterified and bound forms: acetylcholine, phosphocholine, phosphatidylcholine, glycerophosphocholine, and sphingomyelin.

While the body produces choline itself, a choline-rich diet is necessary to meet the dietary needs of infants and adults. Milk producers commonly add choline to infant formula and adult nutritional products to provide the additional supply.

Lactose in Lactose-Free Milk

HPAE-PAD provides a sensitive, accurate method to determine lactose (a major disaccharide) and lactulose in dairy products like milk. Lactose-intolerant individuals are deficient in the enzyme lactase, and so cannot completely catabolize lactose. While the deficiency is not dangerous, its global prevalence has created a large market for lactose-free products, and the need to ensure consumers of presence or absence of such sugars in milk.

Quality Control/Food Labeling

Vitamin A, E and D in Milk Nutritionals

Vitamins, essential to human health, can be classified into two main groups: water- and fat-soluble. Fat-soluble vitamins such as retinol (vitamin A), tocopherol (vitamin E), and radiostol (vitamin D) play specific, vital functions in metabolism. Health problems can result from the presence of too little or too much of these vitamins.

Two-dimensional HPLC allows for the determination of vitamins A, E and D3 in milk-based nutritional samples. It's an ideal QC method to ensure that milk products contain the labeled amounts of those three vitamins.



ONLY be milk.

Contamination

Major and Trace Elements

Milk is known worldwide as a good source of calcium and potassium, plus a number of essential elements such as iron, copper and zinc. Multi-elemental analysis of milk can determine whether milk is meeting the expected nutritional requirements. Alternatively, the analysis of trace elements that are toxic in nature can alert us to the possible risk of contamination in milk.

ICP-MS can make total elemental determinations, including iodine, in a single operation mode. **IC-ICP-MS** can be used for subsequent speciation determinations. Both are important techniques used to keep the milk supply safe and nutritional.

Adulteration

Dicyandiamide in Milk Powder

A simple **HPLC** method can be used to determine the presence of dicyandiamide, used by farmers to minimize the environmental impact of livestock on land, in milk powder samples. Nitrogen-rich compounds, like dicyandiamide, can lead to protein adulteration by making the protein content of food appear higher. Producers often monitor for such contamination in milk and milk powder.

www.thermofisher.com/milktesting



Water should



Contaminants

Toxic Elements

ICP-OES is an ideal tool for the analysis of several toxic elements in drinking and bottled water. The need for such analysis has grown with the popularity of bottled drinking water. That popularity has also prompted many new regulations which apply in the country in which the water is sold and consumed. For example, China and India have seen a huge increase in the consumption of bottled water in the last decade, generating a greater demand for the analysis of toxic elements.

Chlorite, Bromate and Chlorate

Bottled water is disinfected to remove pathogenic microorganisms and ensure its safety for human consumption. Water companies prefer ozone as a disinfectant because it is one of the most effective treatments available, it does not leave a taste, and there is no residual disinfectant in the bottled water. Alternative treatment methods include ultraviolet light and chlorine dioxide.

Reactions between disinfectants and natural organic and inorganic matter in the source water can result in the production of disinfectant byproducts (DBP), such as bromate, chlorite and trihalomethanes, which are potentially harmful to humans. Bromate, for example, can be formed by ozonation of water containing naturally occurring bromide.

IC is a reliable, sensitive technique for the determination of bromate and other DBPs in bottled water.



ONLY be water.

Phenolic Compounds

Phenolic compounds are subject to regulation as water pollutants due to their toxicity.

GC combined with flame ionization detection (FID) and **GC-MS** are the techniques typically used for determining phenols. However, **LC methods combined with UV/DAD, electrochemical, and fluorescence detections** are finding increased application, particularly due to nonvolatiles in many samples that can poison GC columns..

Contaminants

HPLC is used for the simultaneous detection of multiple phthalates in drinking water. Phthalates are a class of chemical compounds widely used as plasticizers for polyvinyl chloride resins, adhesives and cellulose film coating. As endocrine disruptors, phthalates are potentially hazardous to human health—especially children's health. This has resulted in regulation of the types and levels of phthalates allowed in water containers.





Sports drinks be



Quality Control/Food Labeling

Electrolytes

Sports beverages are marketed as a way to replenish electrolytes and water lost during vigorous exercise. Sports beverages present an interesting analytical challenge as their carbohydrates, anions and cations are all functional ingredients requiring determination. Typical solutions often involve separate analytical techniques for each group of analytes.

Due to advances in multi-mode chromatography, a single **HPLC column** with a **charged aerosol detector (CAD)** can provide sensitive detection of nonvolatile and semi-volatile analytes, including carbohydrates, anions and cations.

Vitamin B12

Reversed-phase HPLC with fluorescence, MS or UV detection is a good technique for the determination of cyanocobalamin (Vitamin B12), which can be tricky to analyze.

Plant products contain very little Vitamin B12, so vegetarians and people who don't eat much red meat run the risk of developing a deficiency and pernicious anemia. Fortified drinks help supplement a diet with B12, but consuming too much can cause asthma and folic acid deficiency. It's a delicate balance so typically only low levels of Vitamin B12 (e.g., ng/g) are added to products, making direct analysis difficult. The complicated sample preparation also presents challenges for QC process which have turned to reversed-phase HPLC with specific detectors to monitor the supplement in beverages.

should **ONLY** sports drinks.

Water Soluble Vitamins

Accurate quantitative measurements for vitamins are required to ensure product quality and regulatory compliance.

LC methods are generally used for the simultaneous determination of multiple vitamins of interest and for establishing vitamin profiles with various modes of detection.

- For a clear functional drink with few components, a relatively simple and routine **HPLC** method (e.g., a C18 column with UV detection) is satisfactory for quantifying vitamins.
- For challenging samples with many components, **UHPLC-MS/MS** is the better method with high-throughput, sensitivity and selection for determination of water-soluble vitamins.

Sugar and Salt

The major ingredients in most sports beverages are sugar and salt.

These ingredients can be detected with an **HPLC** system, **CAD** and a **mixed mode column** in a single sample injection using a simple gradient method. The CAD provides sensitive, convenient detection of inorganic ions and nonvolatile sugars, and the mixed mode column is designed to resolve a broad range of anions and cations, mono- or multi-valent and uncharged (neutral) compounds.

HPAE-PAD is an alternative technique that allows direct quantification of nonderivatized carbohydrates with minimal sample preparation.



Cola should



Quality Control

Steviol Glycosids

Beverage manufacturers use Stevia in low calorie beverage products because stevia rebaudiana (Bertoni) is Generally Recognized as Safe (GRAS) in the United States for use as a sugar substitute. Two steviol glycosides – stevioside and rebaudioside A – are often used, with rebaudioside A being preferred for sweeteners. Quantification of the two principal glycosides requires a precise, accurate detection method.

HPLC with CAD and UV detection can overcome the challenges of Steviol glycoside determinations.

Vanillin

Vanillin is a widely used flavor compound in many beverages.

With our revolutionary **solid phase extraction** product, SOLA, and an acid-deactivated polyethylene glycol phase GC column, it is easy to extract and quantify vanillin in cola.

Phosphate and Citrate

Soft drinks are complex mixtures of a variety of substances such as coloring compounds, flavoring agents, acidifiers, sweeteners, preservatives and caffeine. Acidulants reduce a soft drink's pH and thereby assist in preserving it for long-term storage. Acidulants can also be used as chelating agents, buffers, coagulators and flavoring agents.

The most common acidulants used in soft drinks are phosphoric and citric acids. Phosphoric acid is commonly found in colas whereas citric acid is typically added to fruit-flavored beverages. To maintain product consistency and quality, it is critical that an accurate amount of acidulant is used in each production line and bottling facility. Such analysis requires a rapid, accurate and rugged analytical method.

IC can simultaneously determine phosphoric and citric acids in soft drinks by measuring the corresponding anions, phosphate, and citrate.

ONLY be cola.

Quality Control/Food Labeling

Caffeine

Additives are generally put in beverages to preserve flavor or enhance taste, texture, and appearance. Caffeine is a bitter xanthine alkaloid found in the seeds, leaves, and fruit of some plants where it acts as a natural pesticide. It is most commonly consumed by humans in infusions extracted from the seed of the coffee plant, the leaves of the tea bush, and products derived from the kola nut. Caffeine is added to many carbonated beverages.

HPLC with UV detection is a fast, reliable method for determining caffeine concentration in beverages.



www.thermofisher.com/sodatesting

High Performance Liquid Chromatography



Vanquish UHPLC System

The Thermo Scientific™ Vanquish™ UHPLC system leverages new, patented LC technology to boost uptime, extend robustness and increase result reliability. Multiple detection options adapt the system to your beverage QC process or more demanding R&D needs. Outstanding retention time stability, extended sample capacity and simplified operation are just a few areas where your beverage analysis can become easier and more productive than ever before.

thermofisher.com/vanquish



UltiMate 3000 LC System

The state-of-the-art Thermo Scientific™ UltiMate™ 3000 LC family is a UHPLC-ready system with a wide range of performance and workflow automation features. Difficult matrix in your beverages? Challenging in-process samples? Tedious sample preparation moving from the bench to your LC? The Ultimate 3000 system will master challenging samples and routine QC assays with ease.

thermofisher.com/liquidchromatography

Ion Chromatography/ Discrete Analyzer



Dionex Integrion HPIC System

Analyze your beverages for carbohydrates, anions, cations, and organic acids with the Thermo Scientific™ Dionex™ Integrion™ HPIC™ system. Save time and expense with the dedicated Sugar Analyzer that uses electrochemical detection to eliminate the need for sample derivatization.

thermofisher.com/Integrion



ICS-5000+ Reagent-Free HPIC System

For more demanding beverage applications, the Thermo Scientific™ Dionex™ ICS-5000+ Reagent-Free™ HPIC™ system is the instrument of choice. It's a highly versatile, flexible system with a modular design and configurations to meet your toughest challenges.

thermofisher.com/ICS-5000



Discrete Analyzer

The Thermo Scientific™ Gallery™ Plus discrete analyzer provides excellent analytical performance for colorimetric and enzymatic measurements. The automated photometric analyzer covers over 50 analytes for wine, juice and beer testing. Multiple tests can be done on a single sample, and ready-to-use liquid reagents reduce errors and save time.

thermofisher.com/discreteanalysis

Gas Chromatography



TRACE 1310 GC + ISQ GC-MS System with TriPlus RSH Autosampler

The Thermo Scientific™ TRACE™ 1310 GC system, Thermo Scientific™ ISQ™ GC-MS system, and Thermo Scientific™ TriPlus™ RSH Autosampler deliver complete solutions for the analysis of contaminants, flavors and FAMES in beverages. Advanced sampling capabilities, unique instant-connect injectors and detectors, and no-vent MS column replacement provide maximum flexibility, increased productivity, and eliminate maintenance downtime.

thermofisher.com/trace-1310

Combined TRACE 1310 GC and TriPlus 300 HS Autosampler System

Determinations of organic volatiles are comprehensive, automatic and fast with the powerful TriPlus 300 Headspace Autosampler coupled to the TRACE 1310 GC system. The combined system is ideal for determination of water quality, alcohol content, flavor and off-odor compounds in beverages. It offers reliable, unattended high-throughput operation in QA/QC and product development.

thermofisher.com/trace-1310

thermofisher.com/TriPlus300



Trace Elemental Analysis



iCAP RQ ICP-MS System

Expand your analytical capabilities with the Thermo Scientific™ iCAP™ RQ ICP-MS complete trace elemental analysis solution for your high-throughput lab. User-inspired hardware and software combine in the Thermo Scientific™ iCAP™ RQ ICP-MS system to deliver maximized productivity and robustness. Simplicity and ease-of-use features work in concert to streamline workflows and achieve ‘right-first-time’ results; essential to all busy labs.

thermofisher.com/iCAPRQ



iCAP 7400 ICP-OES Analyzer

The Thermo Scientific™ iCAP™ 7400 ICP-OES system provides a powerful, high-performance solution to monitor key toxic elements during beverage production. It ensures accurate labelling of products with nutritional elements while the use of templates, electronic signatures and workflow ensures full traceability of the analytical result.

thermofisher.com/iCAP7400



iCE 3400 AAS Atomic Absorption Spectrometer

The Thermo Scientific™ iCE™ 3400 Atomic Absorption Spectrometer is the ideal solution if your laboratory routinely requires ultra-sensitive detection limits from furnace analysis. The dual atomizer flame and Graphite Furnace AAS with both Deuterium and Zeeman background correction ensures accurate detection of toxic elements as well as high concentration elements for labelling of beverage samples.

thermofisher.com/iCE3400



Columns Hypersil GOLD HPLC Columns



Thermo Scientific™ Hypersil GOLD™ HPLC columns are available in 12 different chemistries to optimize separations and maximize productivity. The extensive range of columns offers chromatographers outstanding peak shape for reversed phase, ion exchange, HILIC or normal phase chromatography. With all 12 phases being available with 1.9 μm particle size, Hypersil GOLD columns offer chromatographers flexibility in choosing the correct column, whether they are using conventional or UHPLC systems.

thermofisher.com/hypersilgold

Accucore HPLC Columns



Thermo Scientific™ Accucore™ HPLC columns provide a unique chromatography solution to enhance laboratory workflow and efficiency. Available in a wide range of stationary phase selectivities and compatible with almost any instrument, these columns provide an excellent return on investment.

thermofisher.com/accucore

Accucore XL HPLC Columns and Titan3 Syringe Filters



Using 4 μm solid core particles, Thermo Scientific™ Accucore™ XL HPLC columns allow users of conventional HPLC methods to enjoy performance far beyond that of columns packed with 5 μm , 4 μm or even 3 μm fully porous particles.

Sample preparation is a key stage in successful chromatography. Thermo Scientific™ Titan3™ and Target2™ syringe filters ensure reliable elimination of both particles and micro organisms in the sample preparation process, providing consistent and reliable experimental results for a range of samples and applications. Titan3 and Target2 syringe filters can also protect chromatography columns by preventing the cumulation of fine particles in the column, which helps prevent premature blockages.

thermofisher.com/accucore

Thermo Scientific
Integrated Software Solutions



Enterprise-Level Informatics & Chromatography Software

The Thermo Scientific™ SampleManager LIMS™ and Thermo Scientific™ Chromeleon™ CDS Link seamlessly connects the powerful Chromeleon Chromatography Data System (CDS) with SampleManager LIMS (Laboratory Information Management System) software. By creating a single laboratory software platform, users will have complete control of all chromatography and/or mass spec instruments, combining two of the most common analytical techniques into a single system with the ability to turn that data into actionable knowledge by providing sophisticated data processing, visualization, search and data mining capabilities.

Chromeleon CDS can help your lab simplify your entire chromatography workflow, giving you better results faster, for fully compliant routine analysis or for flexible research workflows. Chromeleon CDS is the first CDS to unify workflows for chromatography and routine quantitative MS analysis, a new innovation in the food safety lab. Integrated eWorkflows™ streamline all of your analyses on your IC, GC, LC, GC-MS(/MS) and LC-MS(/MS) instruments and contributes to enhanced productivity in your lab.

<http://www.thermofisher.com/chromeleon>

SampleManager LIMS manages your lab's workflow from sample receipt through reporting for regulatory, ISO or HACCP requirements, streamlines SOPs and offers full integration capabilities for connecting instruments, equipment or enterprise systems. SampleManager offers a secure environment for the management of batch relationships and complete traceability of raw ingredients, processed materials and packaged goods.

<http://www.thermoscientific.com/traceability>



Thermo Scientific™ AppsLab Library of Analytical Applications – One-click workflows for use with Chromeleon CDS.

Go to AppsLab Library › <https://appslab.thermoscientific.com/>



Find out more at thermofisher.com/beveragetesting

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